8.50.06 Bridge Engineering

Materials

Road Standards for Inspection of Bituminous Based Waterproofing and Bridge Surfacing

Danish Road Directorate - Danish Road Standards Committee May 1992

Structure of Road Standards

Pursuant to Section 6(1) of the Danish Act on Public Roads (Consolidated Act no. 430 of 31 May 1991 of the Ministry of Public Works), the Minister for Transport may lay down general rules and standards for the construction, maintenance and operation of the public roads, including for the relation between the roads and their surroundings, for contract terms and for such matters as are also of importance to the uniformity and road safety of the trunk network.

Pursuant to Section 24(3) of the Danish Private Common Roads Act (Consolidated Act no. 431 of 31 May 1991 of the Ministry of Public Works), the Minister for Transport may lay down general rules and standards for the construction, extension and reconstruction of private common roads, including for the relation between the roads and their surroundings and for such matters as are also of importance to the uniformity and road safety of the roads.

The future complex of general rules and standards on the road area is referred to as road standards and fall into the following categories: standards, guidelines, guidance.

Standards include fundamental prerequisites and requirements.

Standard texts may include comments, but will not normally specify methods that should or could be used to fulfil the specified requirements.

Standards must be followed at all times. However, the standards may be deviated from if an exemption has been granted by the Minister for Traffic.

Guidelines are rules for use under normal conditions.

Guidelines contain an indication of methods that should be used to solve certain problems and may contain recommendations of standard solutions and standard structures for use under specified conditions.

Guidelines should be followed as far as possible unless specific circumstances mean that they must be departed from or that it is a good idea to depart from them.

In addition to these two categories, the Road Standards may be supplemented as needed by:

Guidance contains advice based on updated experience, and the use will normally be as appropriate.

A booklet of road standards can in theory contain all three categories of road standards. In the text, they will be indicated as follows:

“Standards: Double quotation mark in the margin.

'**Guidelines:** Single quotation mark in the margin.

Guidance: No indication.

. Comments: Full stop and indentation.

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PREFACE

On 18 June 1974, the Danish Road Standards Committee formed a working group with the purpose of preparing proposals for guidelines for waterproofing of concrete bridges, as the following terms of reference were put forward:

Terms of reference

"The working group must prepare proposals for the guidelines for the following types of bridge waterproofing:

1. Bitumen sheet waterproofing with protective concrete
2. Bitumen sheet waterproofing with protective membrane
3. Mastic waterproofing.

The guidelines must include requirements for base and drainage, requirements for materials, design of the waterproofing and surfacing as well as requirements for execution.

In addition, the working group must prepare proposals for where the individual waterproofing types must be used".

Working group

The working group included the following members:

Civil Engineer C.J. Wøhlk, Danish National Roads Laboratory, Chairman,
Civil Engineer H.H. Gotfredsen, Danish Road Directorate, Secretary,
Civil Engineer J.-Chr. Bernhardt, B. Højlund Rasmussen, Consulting Civil Engineers,
Civil Engineer H.P. Forum-Jensen, DSB,
Inspection Engineer L.Q. Hartøft, Danish Road Directorate,
Civil Engineer L. Johnsen, Cowiconsult, Consulting Engineers *AJS*.

Proposal

The working group submitted its proposals for road standards for waterproofing of concrete bridges in November 1976. The Road Standards Committee considered the proposal on 14 December 1976.

Consultation

The proposal was sent out for review in the period 1 February 1977 to the 1 April 1977.

Approval

The working group considered the review given as well as the submitted revised proposals to the Danish Road Standards Committee, which considered and approved the proposal on 13 December 1977. The Danish Road Standards Committee processed and adopted the proposal on 5 January 1978.

Road standard

“Road Standards for the Waterproofing of Concrete Bridges” (Vejregler for fugtisolering af betonbroer) was, apart from minor changes, identical to the provisional version “Road Standards for the Waterproofing of Concrete Bridges”, November 1977.

Revision

In 1988, the Road Standards Secretariat’s project group on Bridge Engineering decided to revise “Road Standards for the Waterproofing of Concrete Bridges” with associated tender and construction specifications, thus taking technical development into account.

Ad hoc group

The work was performed by an ad hoc group under the Project Group with the following members:

Civil Engineer C.J. Wøhlk, Danish National Roads Laboratory, Chairman,
Civil Engineer J.-Chr. Bernhardt, Civil Engineer, B. Højlund Rasmussen, Consulting Engineer *NS,* Secretary,
Engineer J. Borst, Jens Villadsens Fabriker *NS,*
Civil Engineer H.P. Forum-Jensen, DSB,
Civil Engineer L. Jonsen, Cowiconsult, Consulting Engineers *NS,*
Civil Engineer E. Stoltzner, Danish Road Directorate,
Engineer Vibeke Wegan, The Danish National Road Laboratory.

In addition, Inspection Engineer A. Henriksen, Danish Road Directorate, participated as an observer.

Revision proposal

The ad hoc group's proposal includes:

- Design of Bituminous Based Waterproofing and Surfacing,
- Design of Bituminous Based Waterproofing and Surfacing, Appendix of Drawings,
- Design of Thin Pavements with Synthetic Binder,
- Inspection of Waterproofing,
- General Work Specification (GWS) for Waterproofing,
- Paradigms (for special work specification, tender and calculation basis as well as the bill of quantities) for waterproofing,
- General Work Specification **(GWS)** for Bridge Surfacing,
- Paradigms (for special work specification, tender and calculation basis as well as the bill of quantities) for Bridge Surfacing

were processed and approved by the project group on bridge engineering on 7 June 1991.

Approval

The Project Group forwarded material to the Danish Road Standards Committee, which processed and approved the revised and newly added road standards proposals on 10 December 1991. The Road Standards Committee processed and approved the road standards proposals added on 16 January 1992.

Road standards

Road standards for waterproofing and bridge surfacing thus include:

- Road standards for the Design of Bituminous Based Waterproofing and Bridge Surfacing,
- Road standards for the Design of Thin Pavements with Synthetic Binder,
- Road standards for Inspection of Bituminous Based Waterproofing and Bridge Surfacing,

Tender and construction specifications

The above road standards are associated with the following tender and construction specifications:

- General Work Specification for Waterproofing (Section 10),
- General Work Specification for Bridge Surfacing (Section 11),
- Sections 10 and 11 in the paradigm for Special Work Specification for Concrete Bridges,
- Sections 10 and 11 in the paradigm for Tender and Calculation
- Basis for Concrete Bridges.

General information

Concrete bridge decks should be protected against degradation of both concrete and reinforcement by appropriate systems of waterproofing and surfacing. This recommendation is justified by the extensive damage found on bridges – either not waterproofed or inappropriately waterproofed – in Denmark, in other European countries as well as in the USA.

At the beginning of the 1970s, conventional waterproofing of bridge decks in Denmark was made using bitumen sheets with protective concrete and covered with asphalt pavement. On structures such as retaining walls and abutments, "Bituminous Waterproofing" was used on the side facing the ground.

These waterproofing systems were described in the Danish Society of Engineers' "Guideline on the Waterproofing of Concrete Bridges".

In the period from 1975 to 1980, work specifications and design guides were drawn up in the context of the road standards for, respectively, execution and design of the following 3 types of waterproofing:

Bitumen sheets with protective concrete, called Type I,
Bitumen sheets with protective sheet, called Type II,
Mastic waterproofing, called Type III.

Type I has since mainly been used for railway bridges with ballast and for bridges (tunnel pipes) with soil cover or overpass road substructure.

In the 1970s and 80s, Type II was the most used type. It has been shown to be functional and durable.

Type III has not been used since the late 1970s, when it led to a number of performance problems in terms of the establishment of a completely waterproof sheet. Type III was therefore discontinued in 1984.

At the beginning of the 1980s, bonding problems were encountered in connection with the use of the traditional primer – Insulation No. 0 – for bituminous sheets. This initiated a development project financed by the Danish Road Directorate, DSB and DTB, resulting in the development of a range of synthetic primers.

Parallel to this, both waterproofing sheets appeared with a coating mass of the polymer modified bitumen, and synthetic based waterproofing on the basis of polyurethane.

Finally, good Danish experience was registered with thin pavements with synthetic binder of acrylic and similar.

Following the revision, the road standards cover the following types of waterproofing:

Type I to be used in the future only for railway bridges with overpass ballast and soil-covered bridges, or bridges with overpass road substructure.

Type II is used on bridges with heavy traffic, located on significant traffic points in the trunk network.

Types IV a, IV b and IV c containing polymer-modified products are used differently, depending on the traffic load on the bridges and their importance for traffic, in that Type IV a can be used on the same bridges as Type II, while Types IV b and IV c can be used on bridges of less importance or with less traffic load.

As an alternative to Type IV c, **thin pavements with synthetic binder** can also be used**.** When more experience is available with thin pavements with synthetic binder, it must be anticipated that this type can also be used as an alternative to Type IV b.

TABLE OF CONTENTS

1. PURPOSE

These standards are written with a view to enabling local maintenance engineers, bridge engineers and municipal engineers to perform inspections and damage registration, and to initiate repair of bridge surfacing in the maintenance phase (from when the bridge surfacing is newly laid until a main replacement will be effected).

The following materials are categorised according to:

- Asphalt pavements with bitumen sheet waterproofing or with synthetic based waterproofing,
- Thin pavements with synthetic binder

Concerning soft joints, reference is made to previously prepared maintenance standards.

2. INSPECTION AND DAMAGE REGISTRATION

Ongoing inspection by road mender, bridge column supervisor as well as engineering inspection will be organised pursuant to the "Road Standards for Inspection of Structures". Concerning the inspection interval, etc. reference is made to this standard.

A manual registration can be carried out on the pre-printed forms which, as a minimum, contain the following columns for:

- Inspection date and inspector's initials
- Bridge name and number
- Element (pavement, carriageway, etc.)
- Location (the location of the damage)
- Nature of the damage
- Extent of damage
- Recommendation for repair (or not)
- Date for completed repair
- Any comments.

Photographs of significant damage is a valuable supplement.

In the rectification period, damage must be reported to the contractor upon detection.

3. DAMAGE (DESCRIPTION OF CAUSE/REPAIR)

In the following

- Asphalt pavement with bitumen sheet waterproofing or with synthetic based waterproofing
- Thin pavements with synthetic binder

it is specified, respectively, for each typical damage in the context

- Description of damage
- Cause
- Repair.

Generally, regarding cause of damage, it should be noted:

In order to select the correct repair method and to avoid repetitions, it is important to know the cause of damage.

There may be many reasons for damage, and damage may be due to several identical causes. Here, only the most important are mentioned.

Generally, regarding repair of damage, it should be noted:

Minor repairs can normally be carried out without considerable specialist knowledge, while major repairs require a more in-depth knowledge of the surfacing structure, etc.

The season may also be of importance for the choice of repair. Often, you need to fill in a hole with winter asphalt and then, in spring, carry out the actual repair.

The following describes a number of repair methods that especially relate to actual bridge surfacing, while reference is made to the handbook literature when ordinary road repair methods can be used.

4. ASPHALT PAVEMENT WITH BITUMEN SHEET WATERPROOFING OR SYNTHETIC BASED WATERPROOFING

4.1 Insufficient friction

Description	The surfacing has become slippery. The slippery surface may as appear “shiny” asphalt without, or almost without, protruding aggregates, or the slippery surface can appear as worn down “polished” aggregates.
Cause	Bitumen and fine material are pressed up into the surface as a result of a too high bitumen content. - The aggregates in the surface are not sufficiently resistant to polishing.
Repair	Reference is made to "7.00.02 Surfacing, Handbook for Maintenance and Repair Work".

4.2 Fretting

Description	Fretting of aggregates appears as small holes in the surfacing, and this will appear slightly crumbling. Since the holes are often filled with water, they can form the basis for further degradation of the surfacing.
Cause	- Bonding failure between bitumen and aggregates in the surface (stripping). - Too large voids in the surfacing due to inadequate compaction. - Too low bitumen content. Often, it is a combination of these.
Repair	Before the surfacing will appear with actual fretting, only having some degradation, fretting can be prevented locally with sealing (bitumen emulsion with or without asphalt slurry). Where the degradation occurs on the entire bridge deck, a mechanical emulsion sealing can be carried out or an actual surface dressing. If there is material fretting over the entire deck, a new wearing course is usually carried out, including any milling off of old wearing course, if the bridge deck cannot cope with the extra thickness of surfacing.

4.3 Cracks

Description	Cracks can manifest in many forms, e.g. as the fine network cracks (cracking), or as fine or coarse cracks in a longitudinal or transverse direction, as short or long cracks, as superficial or deep cracks (going down through all surfacing layers) or as cracks in the joints. When registering, characteristics like the above mentioned should be used to describe the damage. Fine cracks are easier to see after rainfall with subsequent drying.

Cause

There are many different causes of cracks. However, in principle, cracks are always due to the strength in the crack surface being less than the force that tries to open the crack.

The following causes are the most common:

- Failure in the base.

  This may occur in several ways, e.g.:

  - Cracks in the joints in the base come through the wearing course. This often results in a crack, the width of which grows over time.

  - Settlement in the base, e.g. that an old protective concrete degrades from the bottom and collapses. This often leads to circular cracks in the wearing course.

- Too hard bitumen.

  If the bitumen has become too hard, e.g. with incineration or age, and there are small movements in the base (for example as a result of temperature fluctuations), there is a great risk that the surfacing will crack in cold weather.

- Extreme expansion.

  If a surfacing is exposed to an extreme expansion, for example a surfacing that goes across two bridge elements, which move in relation to each other, a crack might easily occur. These kinds of cracks are often seen at bridge ends of minor bridges, where an actual expansion joint construction has not been applied.

- Cracks in joints.

  The joints in a wearing course may open up later, especially if sufficient heat has not been used when making the joint, or if compaction has been inadequate.

- Tension concentrations.

  With outward facing corners, the corner may easily break off, especially, if the base is not stable enough.

  With recesses in the surfacing, e.g. by gullies, there may be tension points that will cause cracks (often cracks at gullies).

  Immediately before an expansion joint structure, where the thickness of the surfacing is often reduced towards the joint structure, and where the base is not completely stable, the surfacing may easily break under the traffic load, by which cracks occur parallel with the expansion joint.

Repair

In case of bridge surfacing with drainage layer, it is crucial that the cracks are closed quickly, so that road dirt does not percolate down into the drainage layer and blocks it.

Cracks in the bridge surfacing are rarely coarse, but typically up to 3-5mm at the largest crack width.

The following repair methods can be used:

a. Surface sealing of the area with cracks.

b. Special mastic (asphalt slurry), which by using a rubber rake is worked into the cracks after prior cleaning of the crack with pressure water or pressure air, possibly after rough cleaning with a pointed instrument.

c. After the clean-up of the crack, it is filled with the elastic joint sealant, such as Guma 1030, by means of a "funnel".

d. The crack is milled to a width of 10-20mm and a depth of 15-25mm and must be filled with elastic joint sealant, for example Guma 1030 after prior priming. The crack width should be limited as much as possible, and it is only the irregularities of the crack which would cause it to have to be made larger than 10mm.

e. Where the joint cracks from the underlying layer come through a wearing course, this can be repaired by breaking up a 15cm wide area in the wearing course (2 milling groves and breaking up). In the underlying layer the crack is cut into a V-shape and filled with Guma 1030 or similar. The wearing course is then re-established with bituminous joint with aggregate, well blinded with aggregates on the surface to ensure friction.

f. The wearing course is recycled in a suitably wide belt around the crack with special machinery.

Re a and b: These repairs will normally only last for a single winter season, if there is movement in the cracks.

4.4 Bumps

Description

Bumps are generally observed as bulges in the surfacing or as a circular crack (possibly with cracks radiating towards the centre), because the bump has been “crushed” in colder weather.

Bumps may often follow the temperature and therefore appear mostly in hot weather.

Cause

Bumps arise as a result of air and water vapour lifting a surfacing layer.

Often, it is the wearing course that is lifted, because there is no local connection between the wearing course and base course, e.g. as a result of uncleanness on the base course before the laying of the wearing course.

It may, however, also be the waterproofing that lifts.

Here, there may also be several reasons. It may be that the protective sheet is not properly bonded and a void builds between the protective sheet

and the bitumen sheets. It is rarely between the bitumen sheets, but most often between the concrete and the lower bitumen sheet. Via the air channels through the tack coat, air and water vapour originating from the concrete may initiate a very small “bump” (d = 2–5cm), which may later grow larger. The bumps often arise where there is only a thin surfacing (5–6cm) to keep the bump down.

The bumps will appear especially in hot weather.

The only way to determine in which layer the void has arisen, is to break up the surfacing and possibly cut down into the waterproofing.

The above presupposes that bitumen sheet waterproofing is used.

If synthetic based waterproofing is used, and the void is in the water-proofing, it is most likely that it is due to bonding failure between sheet and concrete, allowing water vapour from the concrete to form a bump during hot weather.

Repair

The repair depends on the layer in which the void is located.

If it is located between wearing course and base course, circular breaking up should carried out, as well as careful cleaning of the base and restoration of the wearing course, the joint facing the existing wearing course being thoroughly heated with infrared heat.

If the bump is located in the waterproofing, the surfacing is broken up down to the waterproofing in "steps". The waterproofing is cut with diagonal cuts down to the bump. The triangular shaped flaps are lifted, the surface is thoroughly cleaned, tack coat is applied, and the flaps are pressed down. A square patch of waterproofing is affixed, possibly both in the bitumen sheet and the protective sheet. The patch must be at least 100mm all over outside of the cut. The surfacing is then restored layer by layer. The joint is thoroughly heated.

4.5 Porous surfacing

Description

Porous surfacing manifests itself by often being moist for a while after rainfall, even though the surrounding waterproof surfacing has dried out. It often quickly develops a slightly crumbling surface.

Cause

- Too large void percentage.
- Leaching.

Repair

Is normally sealed with an emulsion, but a surface dressing may also be considered.

4.6 Holes

Description

Holes are easily observed. If they are due to direct traffic impact, they are often called potholes. If they are due to the flaking of the surfacing from an underlying layer, they are often referred to as flaking.

Cause

The most frequent causes for holes are the following:

- Mechanical impacts (road accidents, tracked vehicles, etc.).
- Oil spills.
- Undermining of base course (e.g. crumbling protective concrete or undermining of gravel layer at bridge ends as a result of water movement).
- Too poor compaction, often at the joints.

Cause of potholes:

- Direct traffic impact on the weak surfacing. Small surfacing pieces (e.g. occurring at map cracks) come loose and are sucked up by the traffic. In this way, the impact increases on the hole, which gradually becomes larger.

Cause of flaking:

- The tack coat of the surfacing is ruptured by water pressed down as a result of:
  - Poor cleaning of the base course. -
  - Insufficient bonding.
  - Too large void in the wearing course in relation to the underlying layer. Water issue in the wearing course.
  - Water penetration at poor joints.
  - Too thin wearing course.

Repair

Reference is made to "7.00.02 Surfacing, Handbook for Maintenance and Repair Work".

Since, unfortunately, cracks often occur in joints between repairs and the original wearing courses, it is often recommended to repair with bituminous joint with aggregate, well blinded with small granite aggregates to ensure friction.

4.7 Rutting

Description

Rutting is longitudinal impressions in the carriageway in the tracks where the wheels pass over most often.

Rutting can be seen very clearly in rain where there are longitudinal puddles in the wheel tracks. In dry weather it can be seen if the surfacing is looked at as low as possible across the carriageway. The best observation is obtained by placing a straightedge on the carriageway across the direction of traffic. At the same time, it is possible to measure the size of the rutting.

Rutting will often be more pronounced in places where vehicles are forced to pass in a specific lane, e.g. on narrow bridges.

Cause

The cause of rutting is normally:

- Post-compaction only on the wheel track (e.g., at a narrow bridge).
- Instability in the asphalt layers.
- Wear.

Repair

Reference is made to "7.00.02 Surfacing, Handbook for Maintenance and Repair Work".

In practice, in terms of bridges, it is most often necessary to replace the wearing course, possibly with recycling. Since rutting on the bridge deck often occurs due to instability in the underlying base course, which must be waterproof (low void), it will in some cases be necessary to go all the way down to the drainage layer, which often also must be removed for practical reasons (bonded to the base course). In some cases, it is possible to try to repair with milling of the wearing course and the top of the base course. Afterwards, an extra stable wearing course is laid.

4.8 Depressions

Description

Depressions are local recesses, which clearly appear in rain. They can also be measured with a straightedge.

Cause

The causes are normally:

- Local instability in the surfacing layers.
- Local subsidence in the protective concrete, e.g. as a result of its degradation.

Repair

Local instable layers may possibly be replaced in square fields. Subsidence in the base course is remedied, if this is the cause.

4.9 Instability

Description

Instability means a tendency of road surfacing to develop permanent unevenness during the impact of traffic. Unevenness is formed due to the displacement in the surfacing.

Cause

The cause of the instability is most often:

- Too high bitumen content in the surfacing.
- Too soft bitumen in relation to the traffic load.
- Too large thickness of surfacing in relation to the aggregate size.
- Too high fine-material content.
- Significant increase of the traffic load contrary to assumptions.

Repair

Usually, the unstable layers have to be replaced.

4.10 Leaking waterproofing

Description

Leaking waterproofing can be seen when water percolates through the bridge deck. Besides leaching of the concrete, the moisture may also contribute to the onset of alkali-silica reactions in the concrete under certain conditions. Furthermore, since the percolating water is often salty due to winter management, the chlorine penetration in the reinforced concrete structures may lead to corrosion damage to the reinforcement.

In connection with the previously mentioned engineering inspection, the underside of the bridge deck should also be inspected.

Cause

The most common causes are:

- The sheet is cracked due to unintended deformations, especially in cold weather.
- The flashings are not in order.
- The sheet has been broken by other workmen (e.g. laying of ducts), possibly combined with bonding failure against the sheet.
- The sheet is aged and porous.

The problems may further deteriorate by:

Bonding failure between the layers (only applies to bitumen sheet waterproofing).

- Bonding failure against the concrete, meaning that the water can spread across the bridge deck, until it encounters a crack.

Repair

In individual cases, it is possible to locate the leak in the sheet and to break up and repair it, but in many cases, it is extremely difficult and requires significant, in-depth knowledge of the structure as well as the used materials of waterproofing and surfacing.

Most often, this results in a total re-waterproofing of the bridge deck. In some cases, it has been partially repaired, e.g. only the area around the low line of the bridge deck.

But in many of these cases, it has gone wrong in the joint between new and old waterproofing and, in some cases, percolating water has resulted in alkali-silica reactions and serious degradation in the bridge deck.

5. THIN PAVEMENTS WITH SYNTHETIC BINDER

5.1 Insufficient friction

Description

Lack of friction that is not due to construction errors (frictional aggregates drowned in the surface), can be seen as worn/polished frictional aggregates or as aggregate loss.

Cause

The cause of the lack of friction is normally that the frictional aggregates are not adequately resistant to polishing, or that they are pulled out of the synthetic material.

Repair

General:

Repair of the thin pavements with synthetic binder requires specialist knowledge of the repair technique, and in the event of damage, the supplier of the surfacing should be contacted.

If the supplier cannot be found, a specialist company should be contacted capable of carrying out thin pavements with synthetic binder.

Generally, minor damage can be repaired quickly without any major interruption to the traffic.

If damage has occurred, one should not wait too long to contact the supplier so as to avoid the damage from spreading.

In particular:

For certain thin pavements with synthetic binder, there may be the option to apply a new layer of synthetic material with new frictional aggregates. On the other hand, when the grains are worn, the surfacing is probably old, and a total replacement should possibly also be considered.

5.2 Aggregate loss

Description

Aggregate loss is normally not evenly distributed over the entire bridge deck, but especially in the wheel tracks and thus commonly appears as a “colour difference” in the surface. Close up, it appears that the frictional aggregates are missing in the surface, and possibly holes in the synthetic material are seen where these once were.

Cause

Loss of frictional aggregates in the surface is normally caused by inadequate bonding between the aggregate and synthetic material. Again, this may be caused by an incorrect (smooth) aggregate type or an incorrect composition of synthetic material, for example, that it becomes soft and loses its bonding ability or it has rained on the surfacing before hardening completely.

Repair

General:

See Section 5.1.

In particular:

Depending on the age of the surfacing, the type and scope of aggregate loss, repairs may be carried out locally by laying out a new layer of surfacing with frictional aggregates on top of the existing surfacing.

5.3 Flaking

Description

Flaking is easily seen. They commonly start in the wheel tracks.

Cause

Flaking between the concrete and thin pavements with synthetic binder is due to poor bonding, often as a result of insufficient preparation of the base course (cleaning, sandblasting). It may also be due to an incorrect primer, which is deteriorating due to moisture (and alkalis, etc.) in the concrete.

Flaking between the individual layers in the thin pavements with synthetic binder may also occur and is normally due to

- Too early or too late blinding on the first layer
- Too late application of second layer.

For acrylic surfacing, it can be due to insufficient removal of paraffin layer on the surface.

Repair

General:

See Section 5.1.

In particular:

Smaller areas with flaking can possibly be repaired locally. Larger areas should normally be resurfaced, possibly only the wearing course, if it is only this course that is flaking, and provided that all of the original wearing course can easily be removed.

5.4 Bumps

Description

Bumps are generally seen as bulges in the surfacing or as circular cracks as a result of the bump being “crushed” in cold weather.

Cause

Bumps arise when air and water vapour elevate the surfacing. Bumps often occur where there is poor bonding between the concrete and surfacing.

Repair

General:

See Section 5.1.

In particular:

Minor areas with bumps can usually be repaired locally.

In case of large areas resurfacing should be considered. Another type of surfacing should possibly be considered, if the concrete base is the cause of the bump formation.

5.5 Degradation of synthetic material

Description	Degradation of the synthetic material often appears when the mass has become hard/crisp. This may cause it to crack and possibly flake off.
Cause	Degradation is normally due to an incorrect chemical composition of the material. The defect could also have occurred in connection with the mixing, or if certain chemical properties were damaged beforehand, e.g. due to incorrect storage. For old thin pavements with synthetic binder, the degradation may be due to a “natural” aging of the material. Certain substances are not light resistant and must be covered by other substances. Failure to do so will result in degradation.
Repair	*General:* See Section 5.1. *In particular:* As a rule, a re-surfacing must be done unless it relates to a very limited area which can be repaired locally.

Danish Road Directorate
The Road Standards Secretariat

Carsten Niebuhrs Gade 43

DK-1577 Copenhagen V

Telephone +45 72 44 33 33

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